SHIELD OPTIMIZATION
for 2018 Drell-Yan RUN

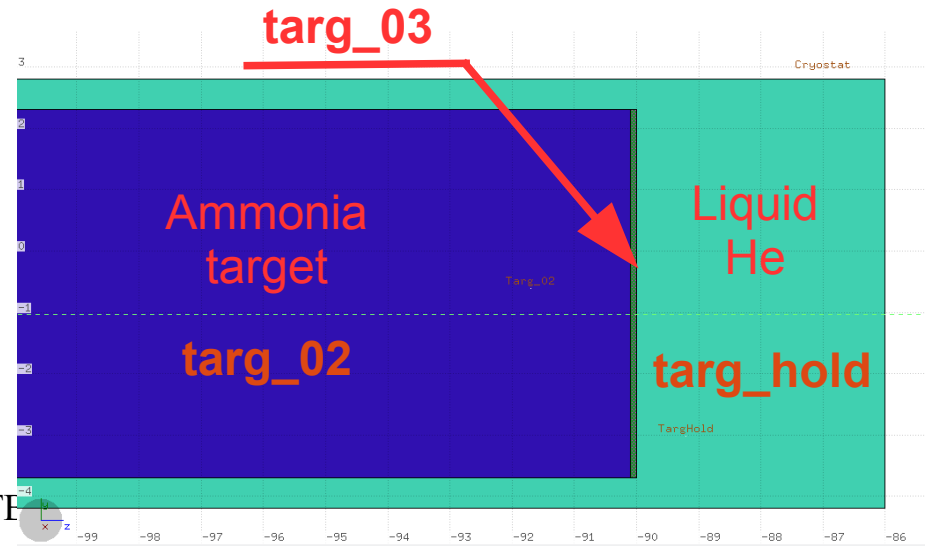
- Decrease the neutrons crossing MM01
  - Discussed last summer
- Check the backward particles on polarized targed
  - Study the possible loss of polarization due to the ionization caused bu backward particles produced in the absorber or in the secondary target
- Study of the radiation dose in the environment around Bat. 888
  - Realistic dose based on the run 2015:
    - $3.9*10^8$ π^-/spill – 203 days – 486476 spill
    - It was 10^9 π^-/spill in 2010-2013

General informations

- The fluka simulations has been cross-checked by radioprotection group
  - Very good agreement
  - Fluka is a flexible tools with many switch: EMF, EWTMP, AMB74
- Fluka now run on BLUE WATERS
  - Thanks to the help of Caroline, Marco and Riccardo
    - In alphabetic order
  - Was really a difficult task. Fluka was written in Fortran and require a proper environment to be compiled
  - BLUE WATERS is an incredible powerful system but is non “user friendly”
  - In addition, , I was rather rusty after 4 years of not using it
- Thanks als to Alain for the stimulating discussions
  -

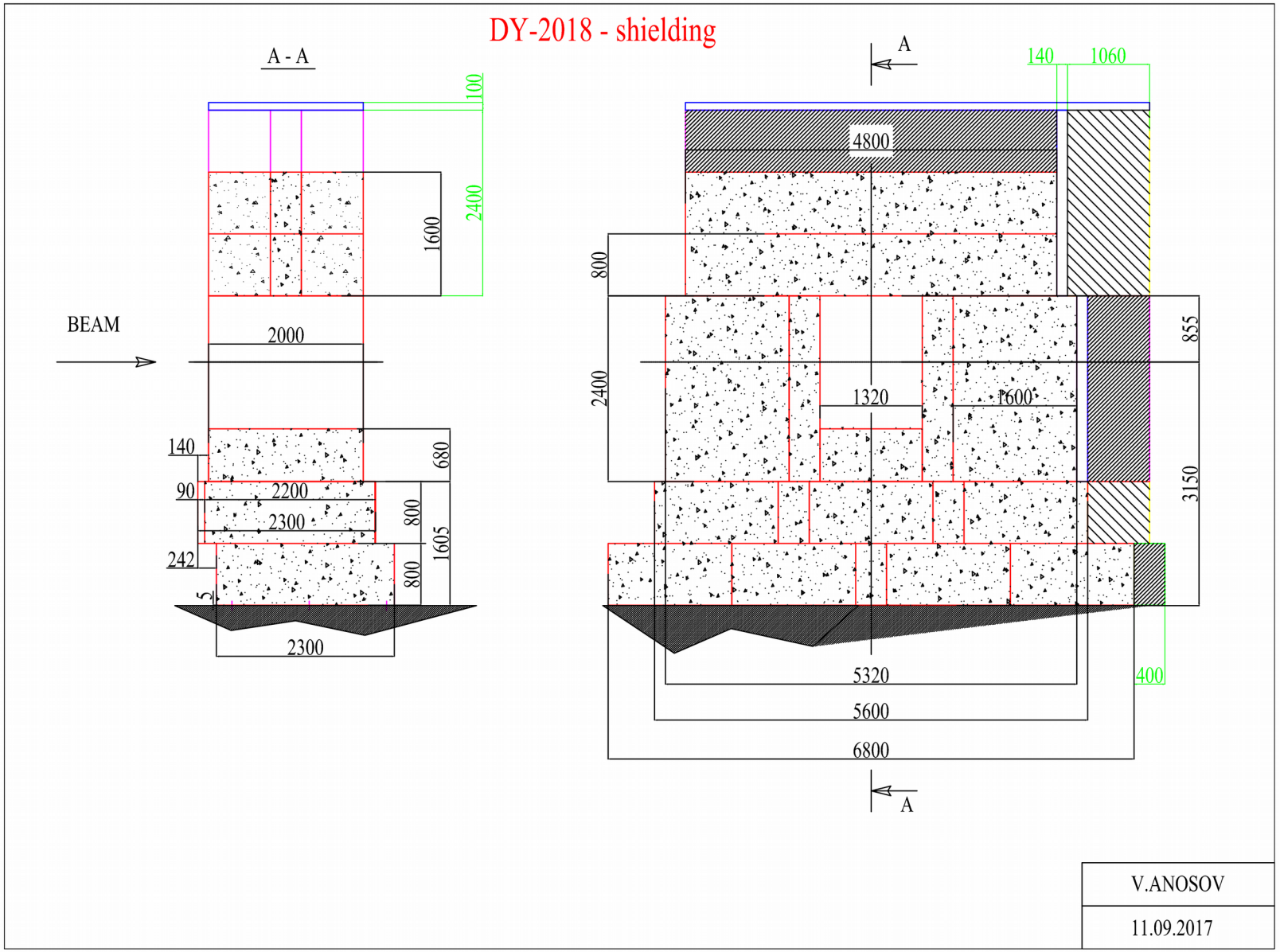
Definition of forward and backward particles on downstream polarized target

- Downstream polarized target, 55cm long, is divided in two parts:
  - The first, called targ_02, is 549.9mm long
  - The second, called targ_03, in close contact with the first, is 0.1mm thick
- Both targets are filled with ammonia in a form of spherical droplets, immersed in a volume filled with LHe, called targ_hold (material budget given by Jaakko)
- **Forward:** charged particles crossing the surface from targ_02 and targ_03
- **Backward:** charged particles crossing the surface from targ_hold an targ_03
  - Since the targ_02 and targ_03 are in close contact, only the particles with direction downstream to upsteam are scored
  - it's include also the particles crossing the side surface but the surface ratio between side and backward surface is small, 0.6%



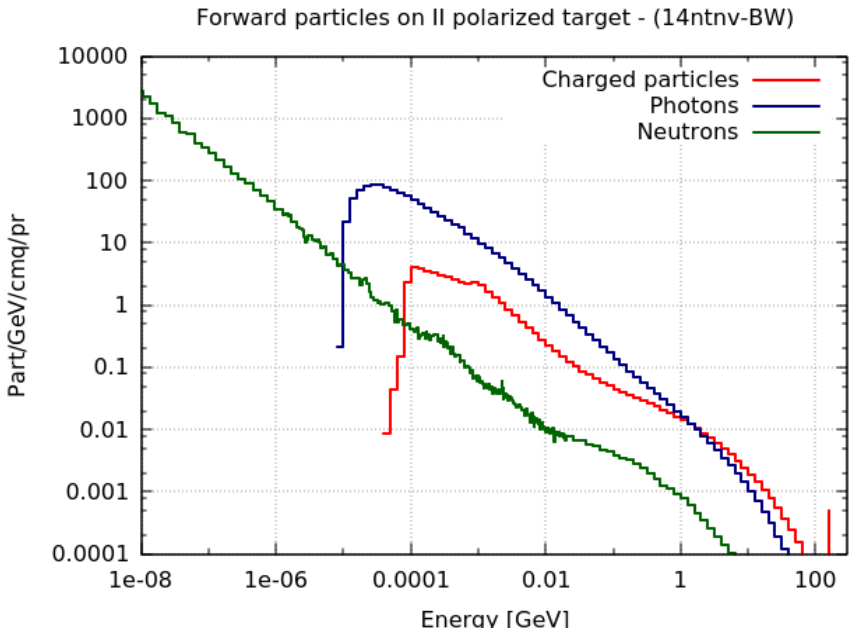
Environment dose reduction

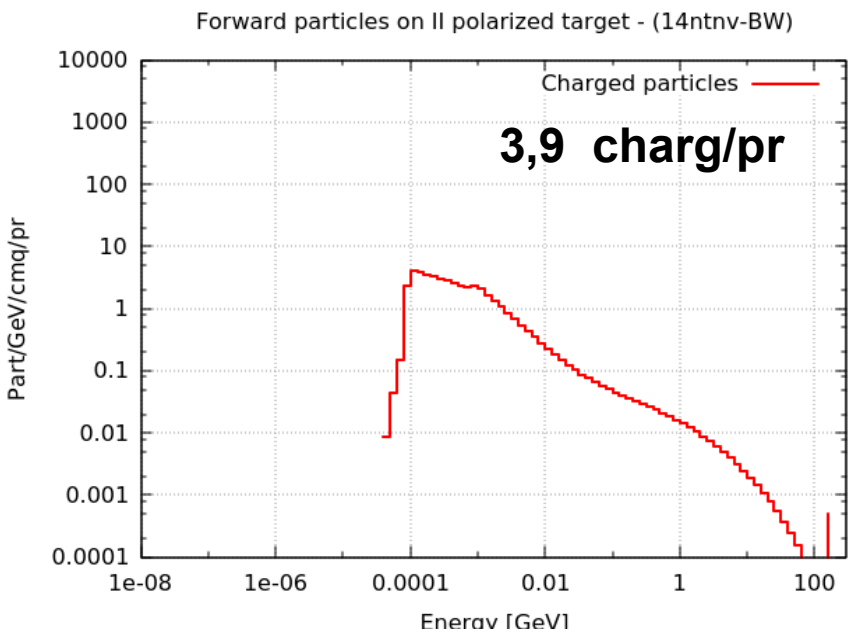
First version of additional shielding suggested by V. Anosov

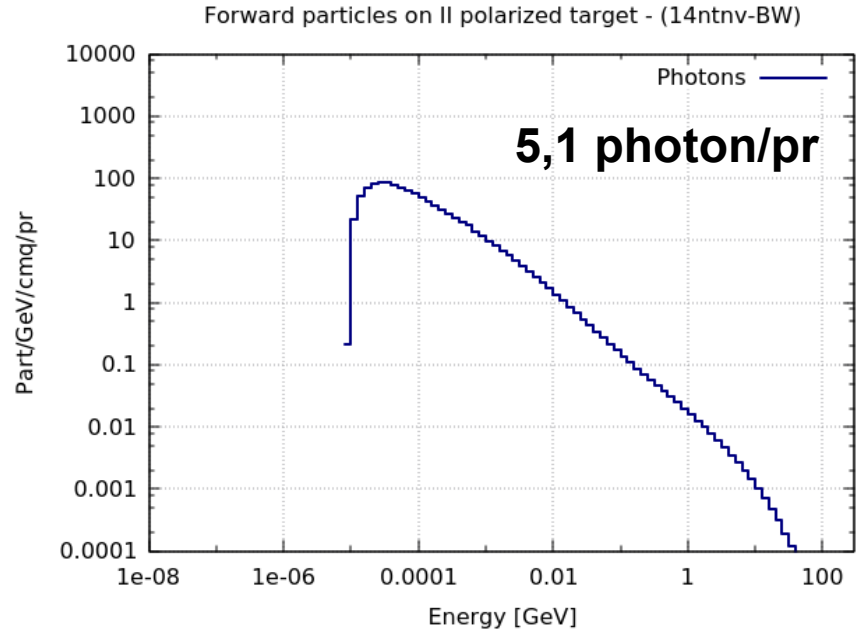


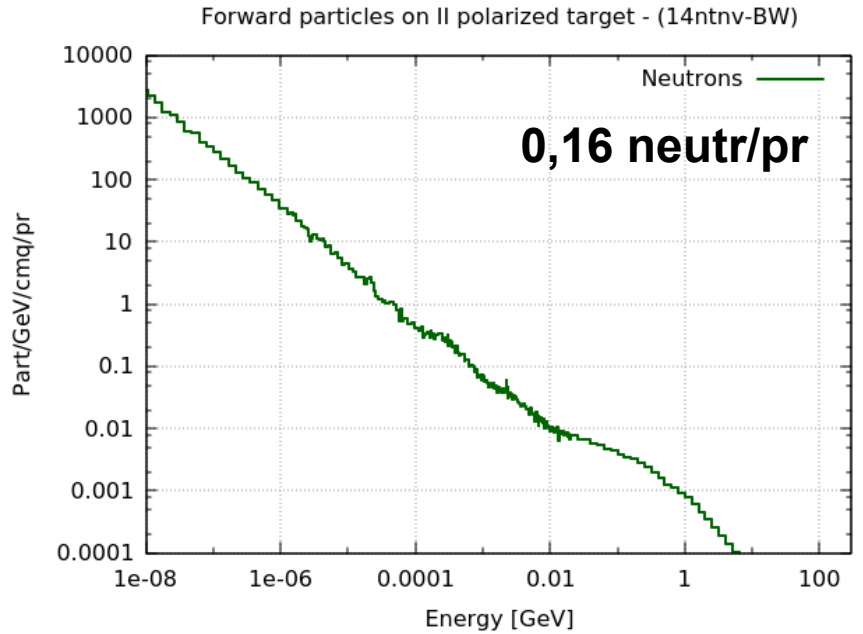
Energy of forward particles

final-14ntnv (valid for all configurations)



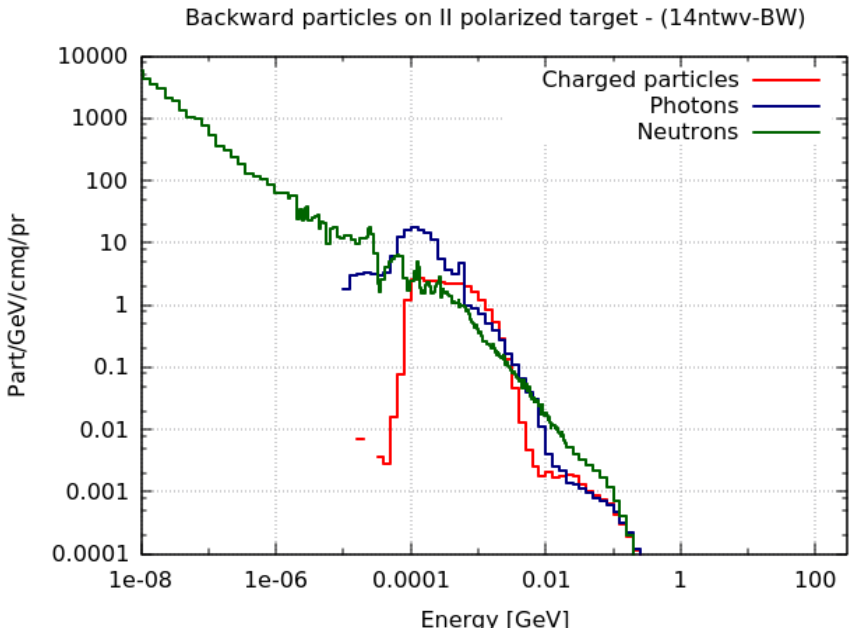


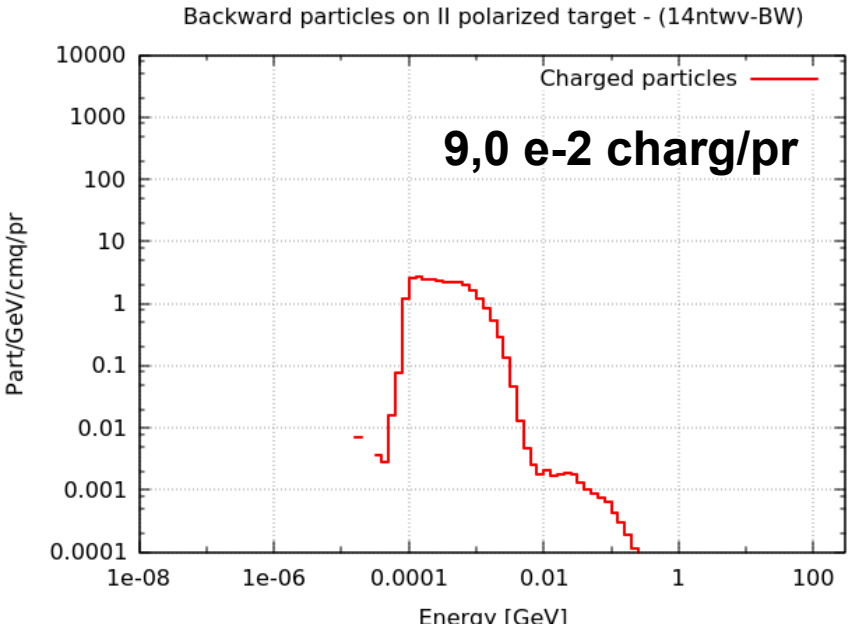


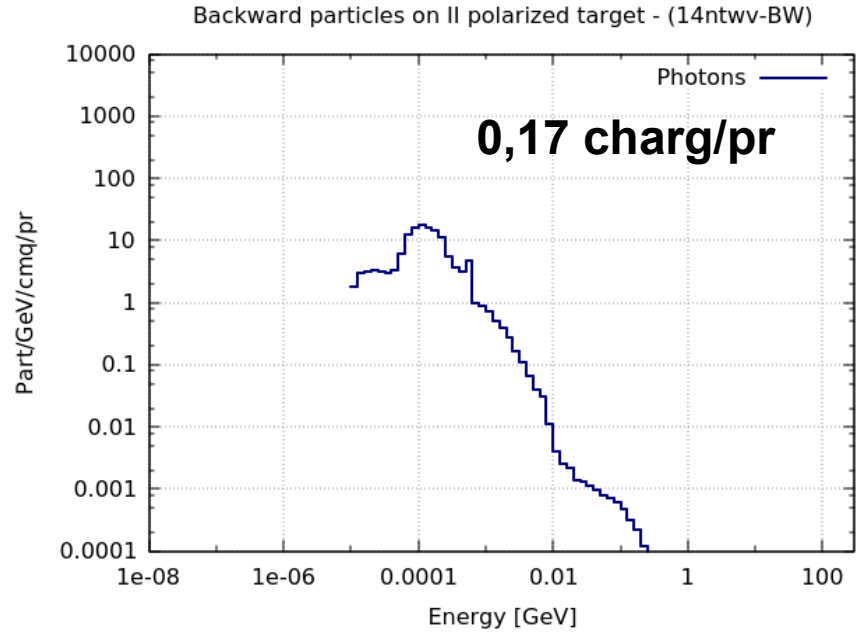


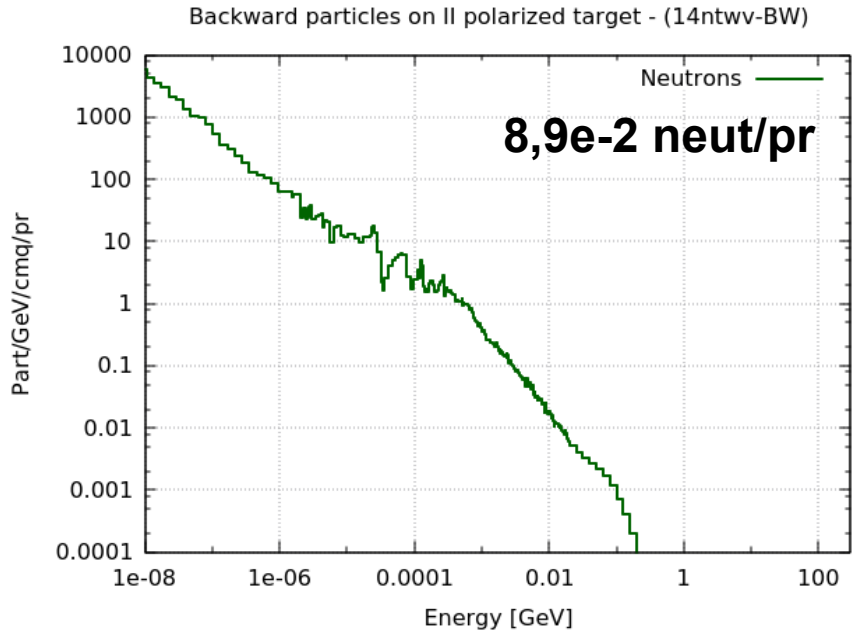
Energy of backward particles

final-14ntnv









Flux of forward/backward particles on downstream target

Part/pr

	Forward charged	Forw photons	Forward neutrons	
Final-13	3,9 ± 0,1%	5,1 ± 0,2%	0,16 ± 0,3%	**Run 2015**
	Backward charged	**Bacward photons**	**Backward neutrons**	**note**
Final-13	9,2e-2 ± 0,3%	0,16 ± 0,3%	5,0e-2 ± 0,4%	Run 2015
Final-14	9,1e-2 ± 0,3%	0,16 ± 0,3%	5,1e-2 ± 0,4%	F13 + additional shield
Final-14ntnv	9.0e-2 ± 0,3%	0,17 ± 0,3%	8,9e-2 ± 0,3%	F14, no secondary target
Final-15	9,1e-2 ± 0,4%	0,19 ± 0,3%	9,6e-2 ± 0,3%	F14 + tungsten target
Final-16	9,1e-2 ± 0,3%	0,17 ± 0,2%	6,4e-2 ± 0,4%	F14 + 10cm nickel target
Final-17	9,1e-2 ± 0,3%	0,16 ± 0,3%	6,4e-2 ± 0,4%	F14 + 5cm nickel target
Final-18	9,1e-2 ± 0,4%	0,17 ± 0,3%	6,5e-2 ± 0,4%	F14 + 5cm nickel target, middle I-II layer
Final-19	9,1e-2 ± 0,3%	0,17 ± 0,2%	6,7e-2 ± 0,3%	F14 + 10cm nickel target, middle I-II layer

The number of backward particles are 2% of the forward particles in any configuration

Run 2015

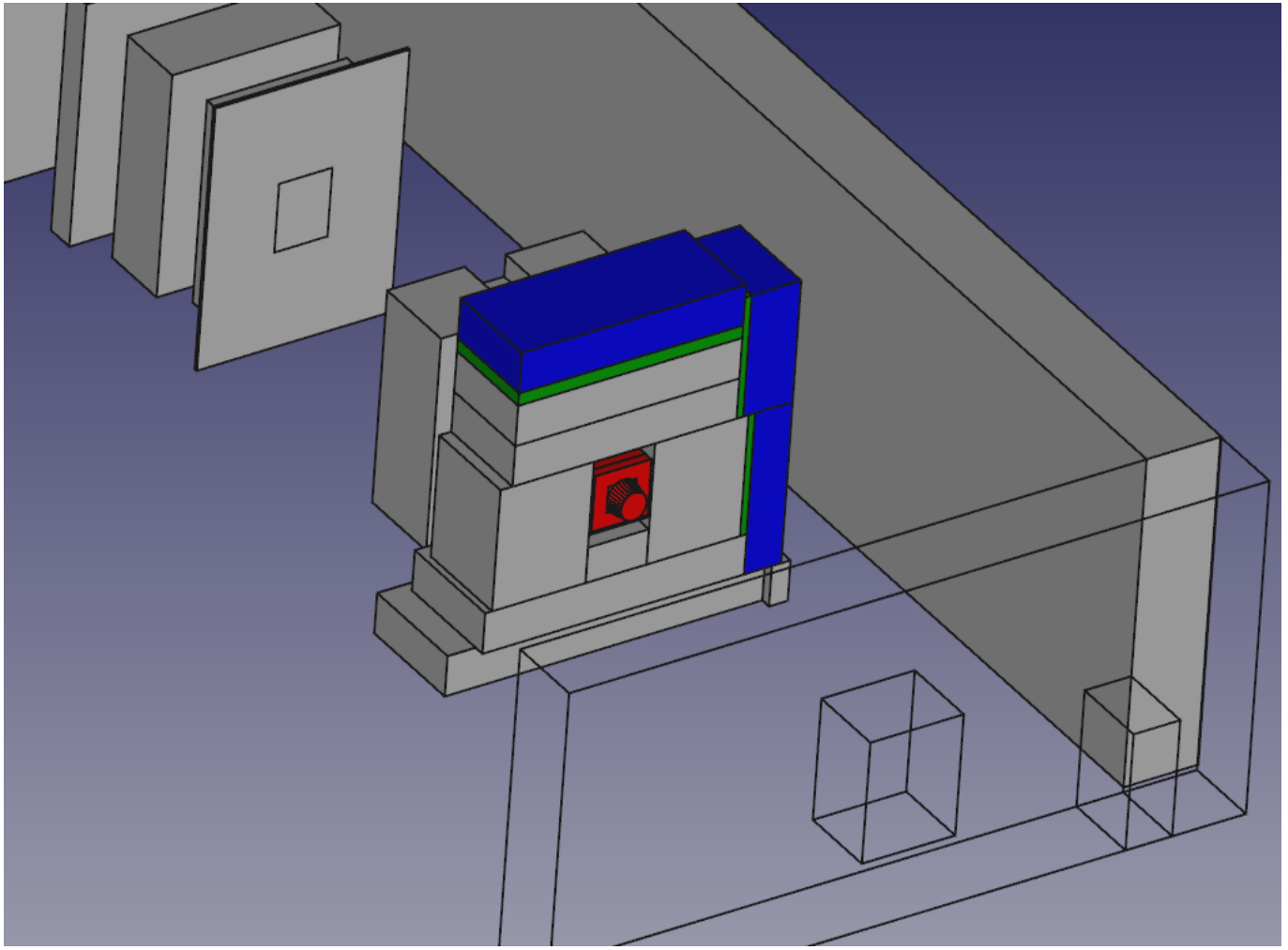
best configuration

worse configuration

Dose in the environment RP request

- Reduce by 30% the dose measured by the environmental monitor placed on the CERN fence, Saleve side
  - Swiss and european low restrictions:
    - Maximum 1 mSv/y
- The dose outside the building 888, road etc,
  - Public road without any traffic restriction
    - below 2.5 μSv/h

Version 2



Safety problem due to flammability?

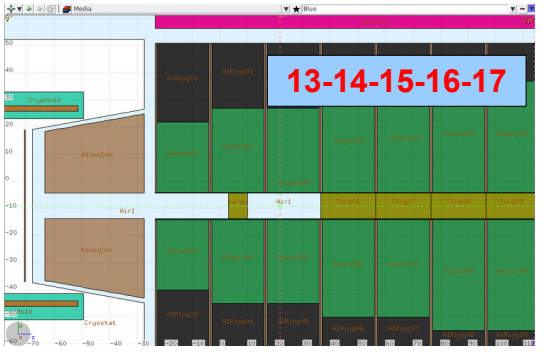
In principle not; standard polyethylene grades have low thermal conductivity, it will combust if it comes in contact with a direct, high intensity heat source (such as an open flame), but does not maintain a flame by itself for long

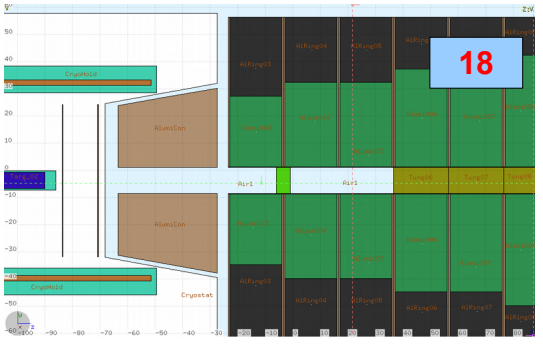
In our case, it is sandwiched between concrete. We can close the open side with aluminum layesrs

- Vladimir was able to find unused borated polyethylene at CERN for free
- We can replace the polyethylene witn b-polyethylene
- Add b-polyethylene on top (25cm)
- In contact with the spokeperson of t-TOF, no answer for the moment

Summary of the simulations

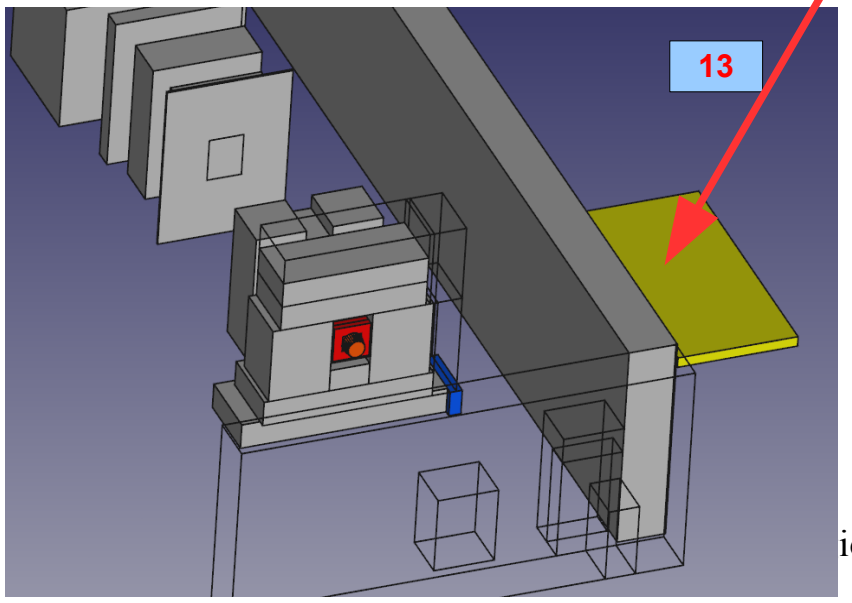
configuration	note
Final-13	configuration of 2015 run, secondary target included. Additional shield filled with air
Final-14	Final-13 with additional shield filled with concrete and polyethylene
Final-14nt	same of Final-14 but without secondary target
Final-14ntwv	same of Final-1nt 4, without sec. Target but with vertex detector
Final-15	Final-14 + tungsten target, 7cm length, z = 30cm (middle of II layer
Final-16	Final-14 + nickel target, 10cm length, middle of II layer
Final-17	Final-14 + nickel target, 5cm length, middle of II layer
Final-18	Final-14 + nickel target, 5cm length, begin of II layer
Final-19	Final-14 + nickel target, 10cm length, begin of II layer

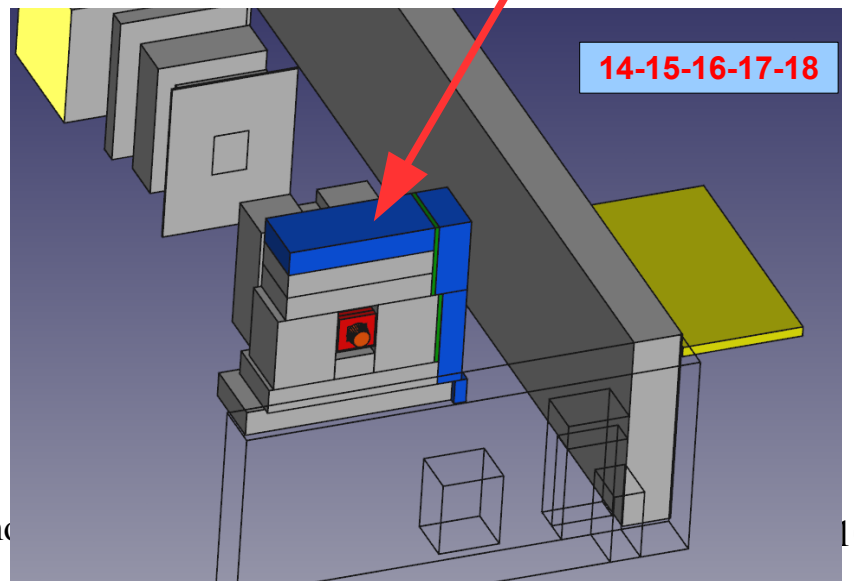




Volume of mean dose

Additional shield

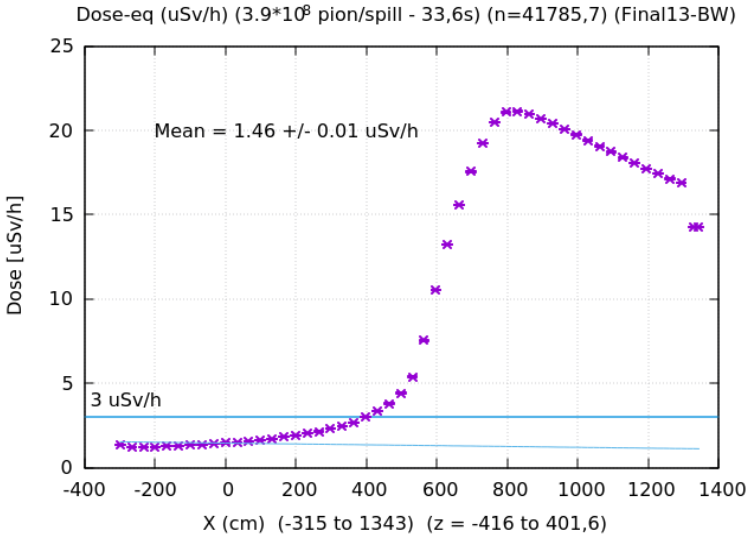


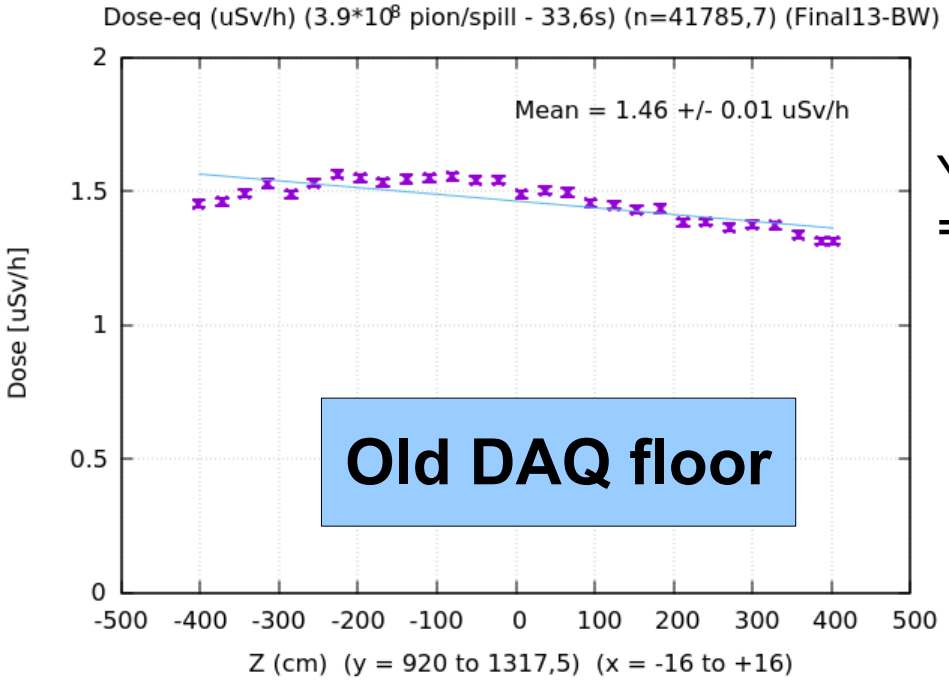


RUN 2015 – summary (F13)

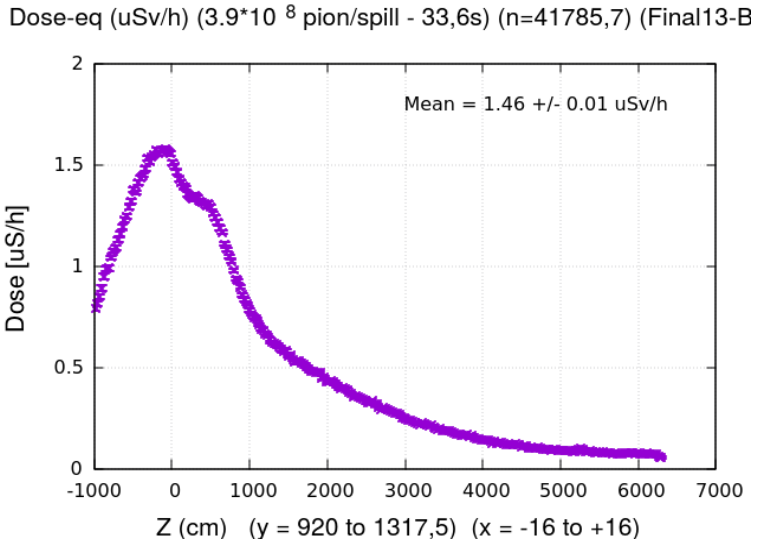
(thanks to Michela)

- Total number of days : 203
- Total number of spill on target: 486476
  - Mean SPS cycle: 36” (MD included); 33,6” no MD
- Mean π-/spill: $3.9*10^8$
- Fluka correction factor for μSv/h: 41785.7
- Fluka correction factor for mSv/y: 189726





Y = Compass X
= Saleve



Dose on 888 control room

Run 2015: 203 days, total spill=486476, 3.9*10^{8} π^-/spill, SPS mean cycle=33.6”

configuration	Mean dose in control room (µSv/h)	Dose Reduction	note
Final-13	1,46 ±0,01	0,0%	configuration of 2015 run – vertex det and secondary Al target included – no additional shield
Final-14	1,34 ± 0,01	-8,2%	Final-13 + additional shield
Final-14nt	1,35 ± 0,01	-8,1%	Final-14, no vertex, no target
Final-15	1,53 ± 0,01	4,8%	Final-14 + tungsten target
Final-16	1,41 ± 0,01	-4,1%	Final-14 + 10cm nickel target
Final-17	1,38 ± 0,01	-5,5%	Final-14 + 5cm nickel target
Final-18	1,40 ± 0,01	-4,1%	Final-14 + 5cm nickel target, begin II layer
Final-19	1,47 ± 0,01	1,0%	Final-18 + 10cm nickel target beginning of II layer

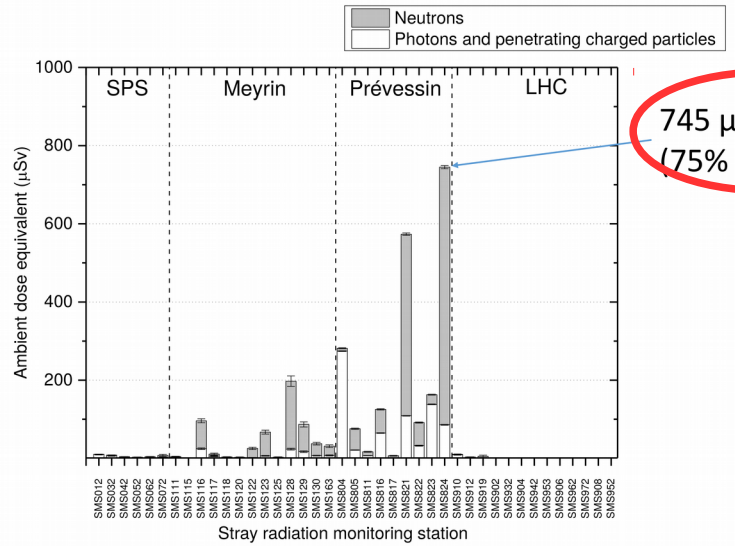
- With this additional shield,V1, we are far from RP request -30% (max -8,2%)
- With tungsten instead of Aluminum, worsens 2015 run
- With 10cm of nickel, worsens 5cm
- Upstream position is worse than middle on II layer

Environment radiation monitor

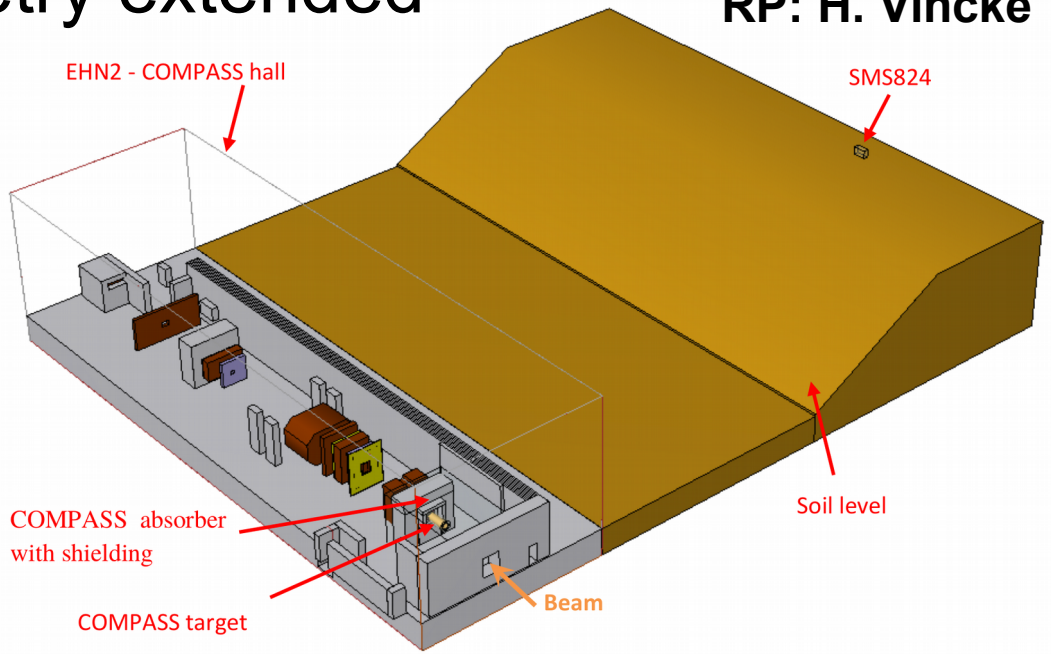
fluka geometry extended

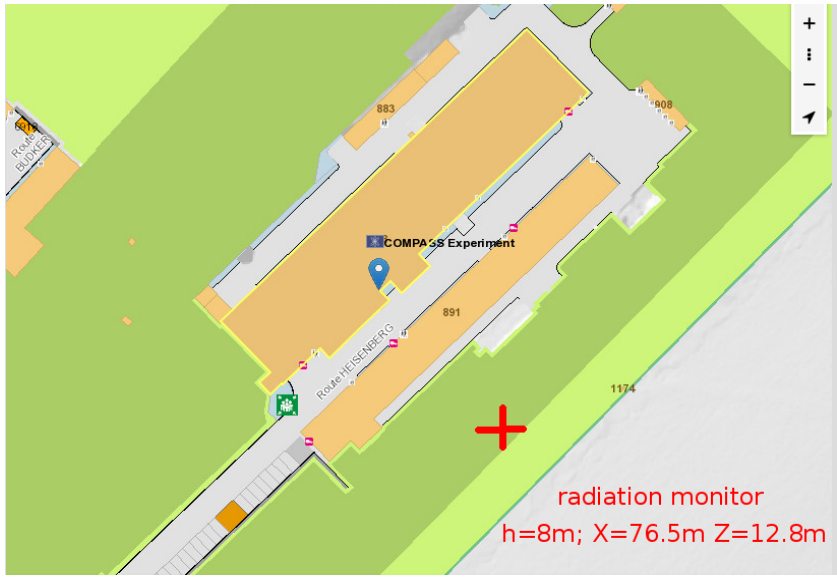
RP: H. Vincke

- Simple extension
  - No 888 and 891 walls
  - No barracks

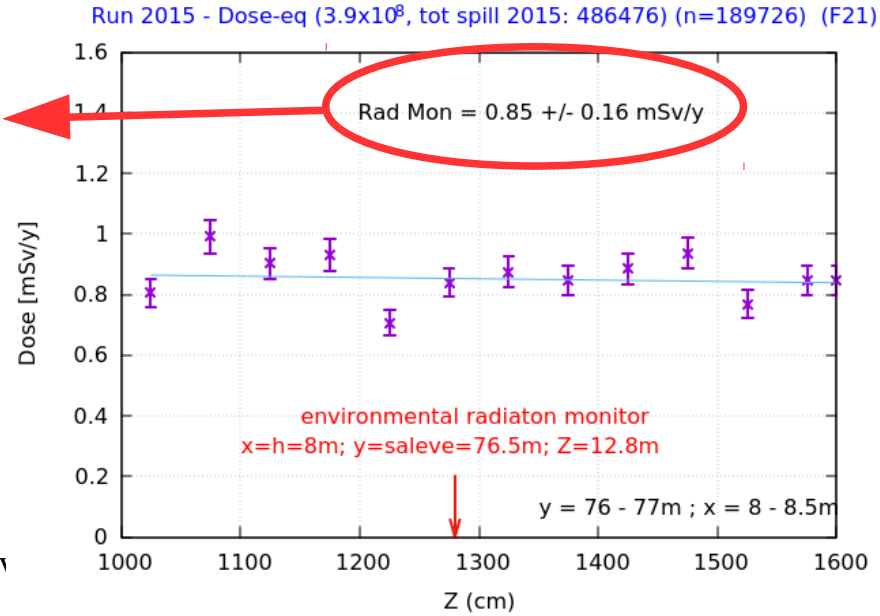


745 µSv (in 2015)
(75% of the limit)





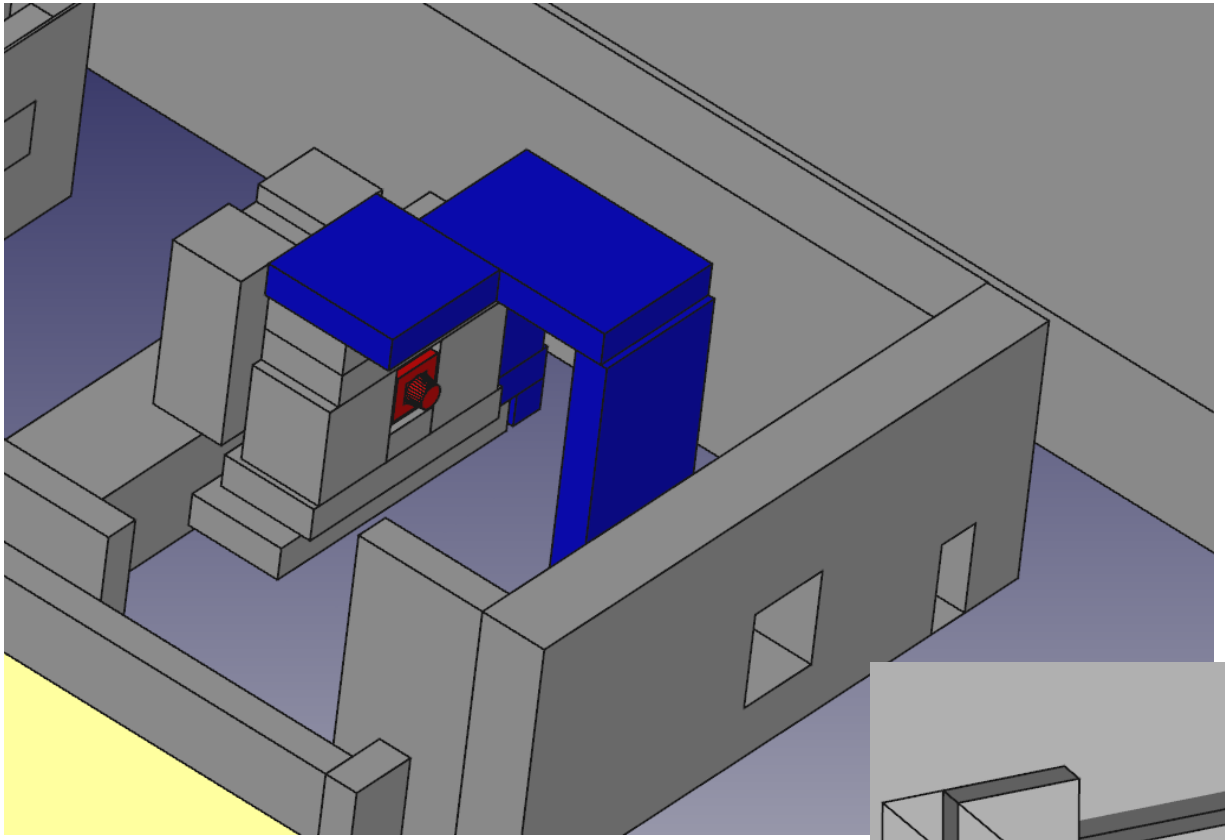
12%



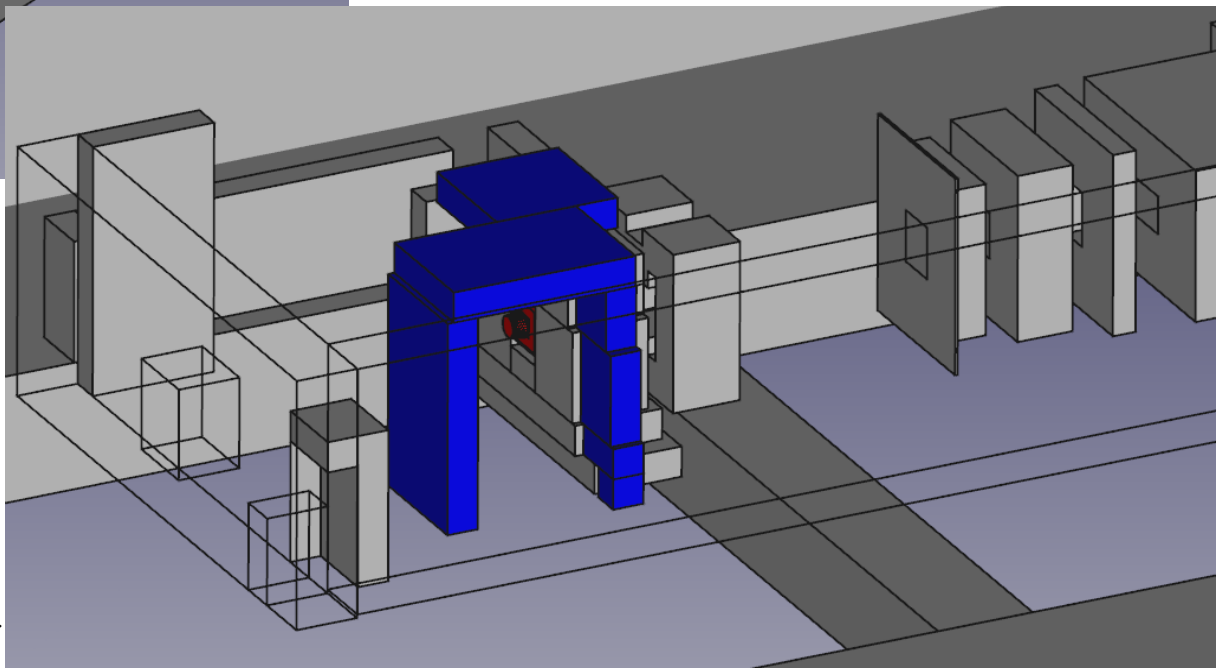
RUN 2018 environment monitor

- Total number of days : 217 (+7%)
- Total number of spill on target (scaled down): $520*10^3$
  - SPS cycle: 33,6”
- Mean π-/spill: $3.9*10^8$
- Fluka correction factor for μSv/h: 41785.7 (33,6s)
- Fluka correction factor for mSv/y: 202800

New shielding from RP discussion

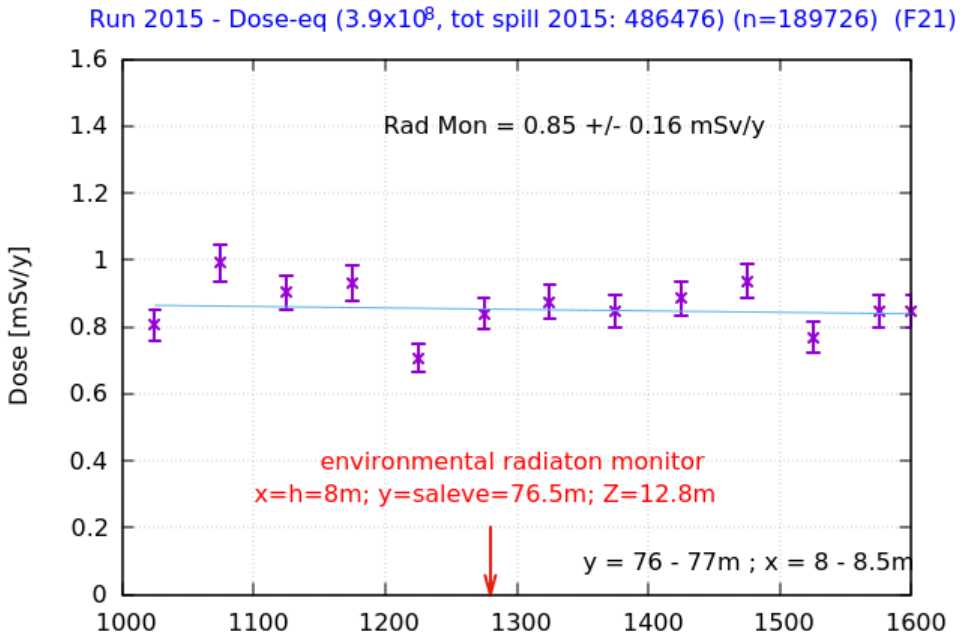


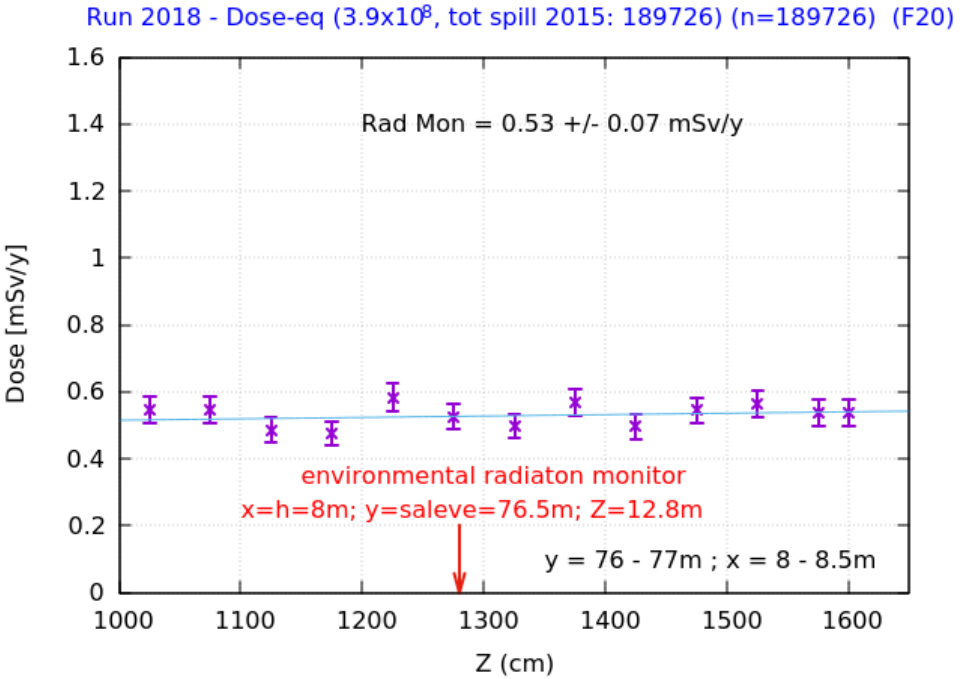
- Only concrete blocks
- Roof extended upstream
- “umbrella” on the side of PT target

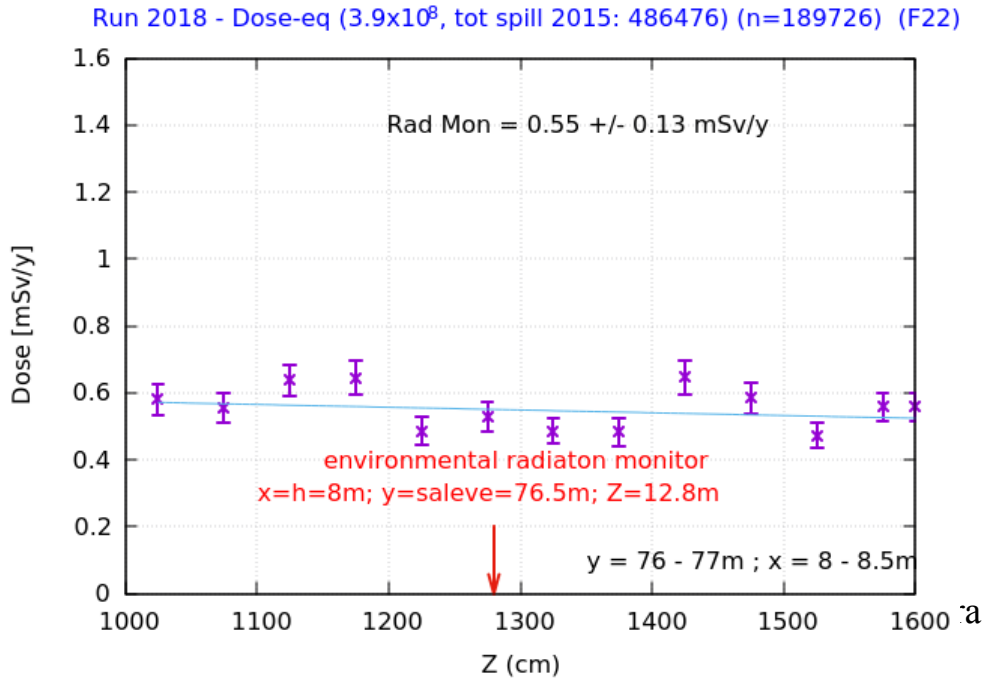


A.

Simulations of Environmental Rad Mon

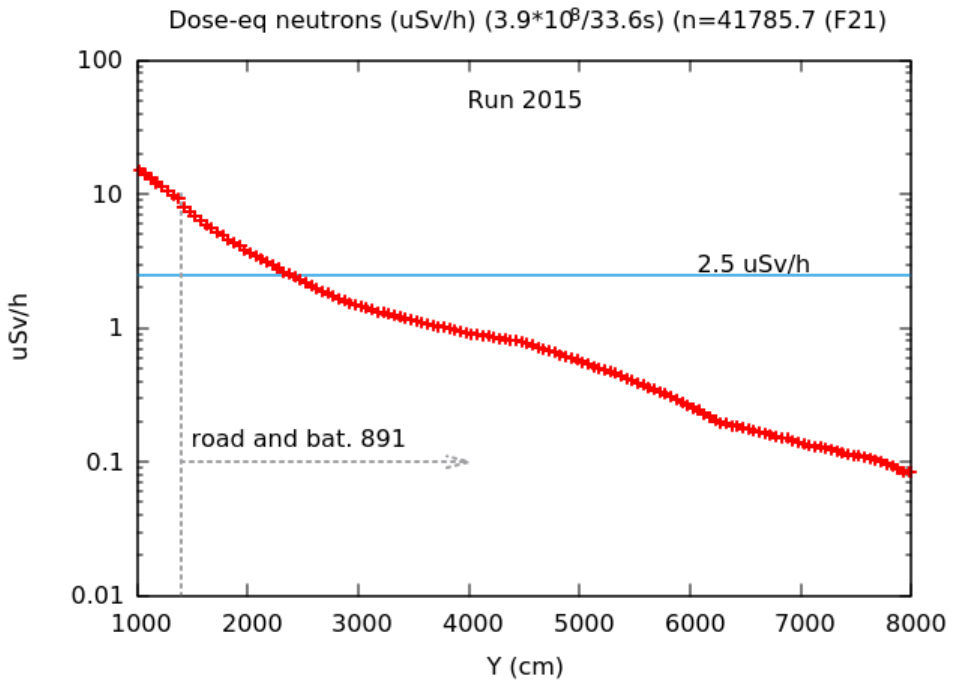


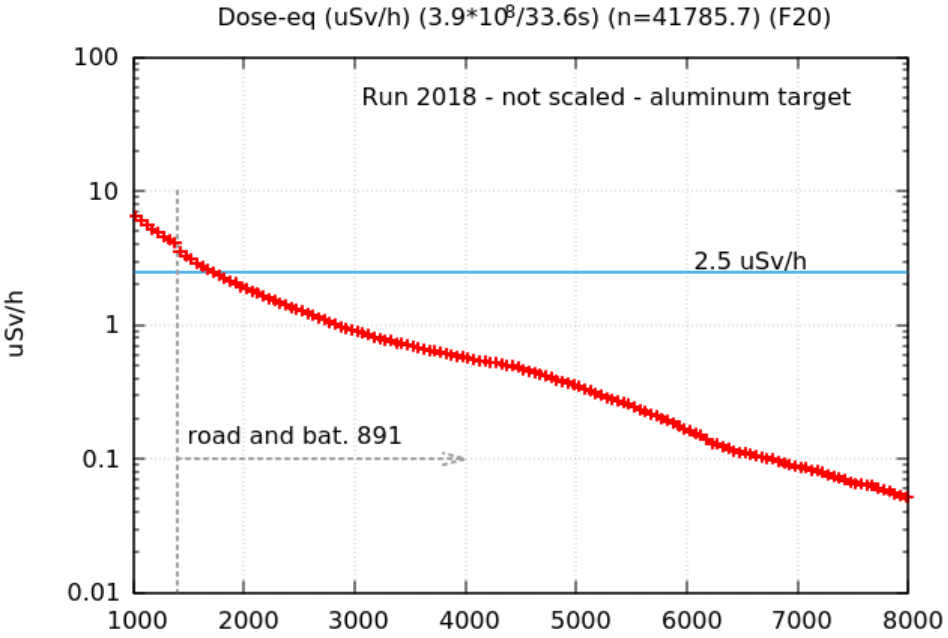




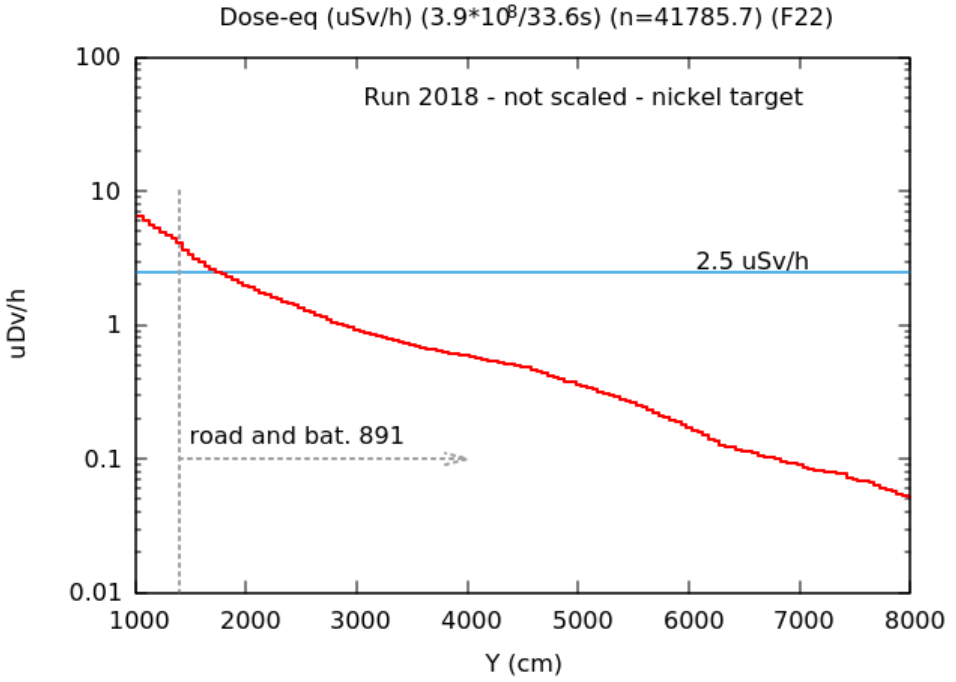
	Normalized to run 2015	Scaled by n. days 203/217	Ratio to run 2015 (scaled)
Run 2015	0,85	0,85	
Run 2018 no II target	0,53	0.57	-33%
Run 2018 nickel target	0,55	0,59	-31%

Dose on the road, up to CERN fence, Saleve direction



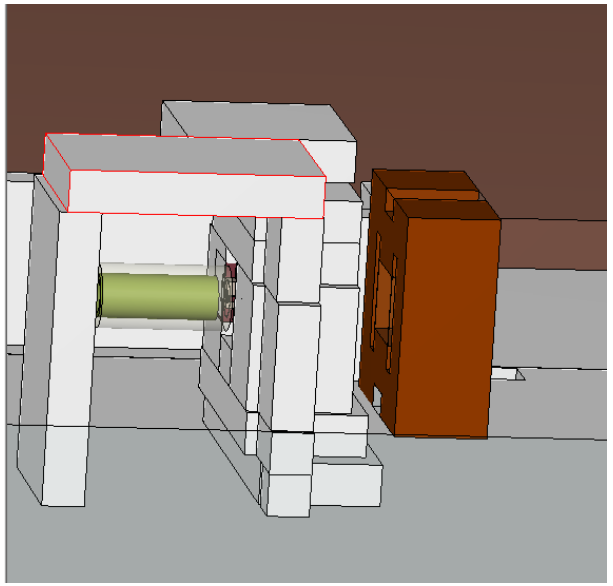


- During the run 2015, the dose was a lot higher than 2.5 mSv/h
- The new shielding improves considerably over run 2015 but still exceeds the requirements
- Any difference with Al and Ni target

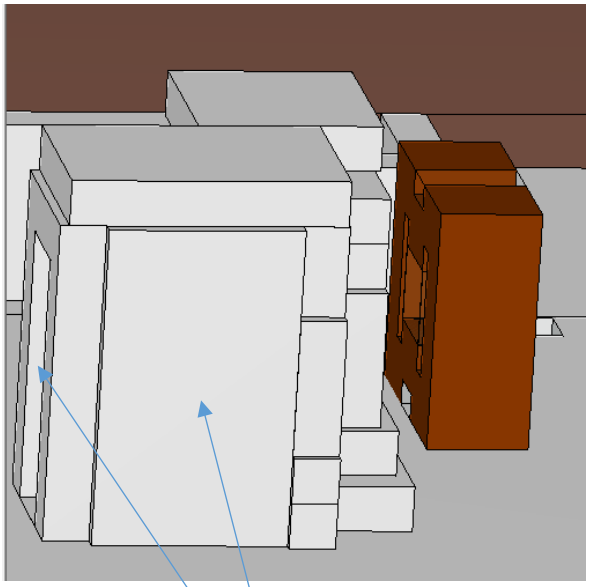


Last news from RP

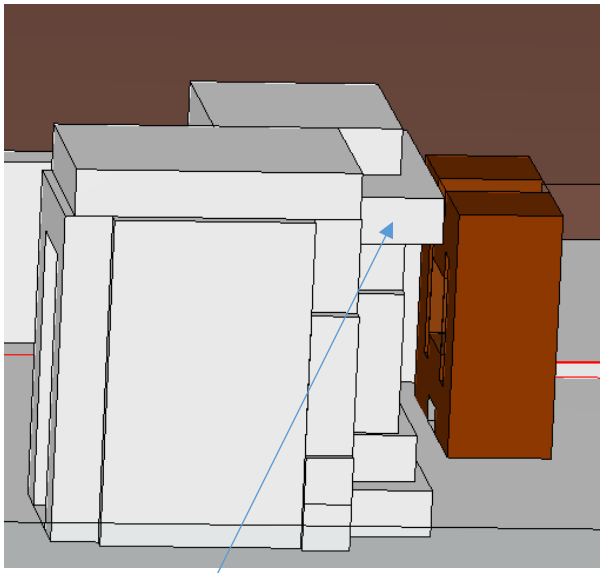
Heinz Vincke



Final-22



Final 23
location of ‘opening’ changed



Final-24
shielding of top of absorber moved in z direction by 80 cm

Conclusions

- The number of charged particles generated somewhere downstream the polarized targets and hitting the II target are negligible compared to the forward particles generated by the interaction on the targets, also in the worse configuration with W secondary target
- The first shielding version do not fulfill the RP requests, either for the dose on road and environment
- The new shielding is close to the requests but:
- **We must still improve the top shielding**

RP cross-check in progress

My personal conclusions

- If in the future Compass need this studies:
  - I am a hold man, tired and retired
  - my mind slows more and more
  - my priorities are now
    - the vegetable garden and my countryside, tomatoes, peppers and zucchini
    - Microcontrolled drop by drop irrigation system
  - **Compass need a replacement with young and more efficient person!!!!**

My run 2017